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CLEGG'S DIFFERENTIAL DRY GAS-LIGHT METER.

BY PROFESSOR VIGNOLES, C.E.

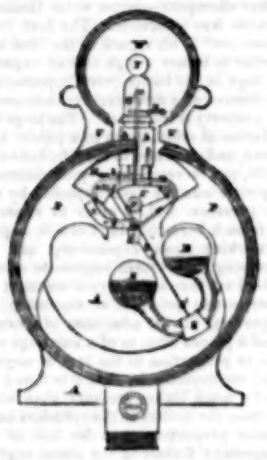

Fig. 1.—Front elevation, with the case of the meter removed.

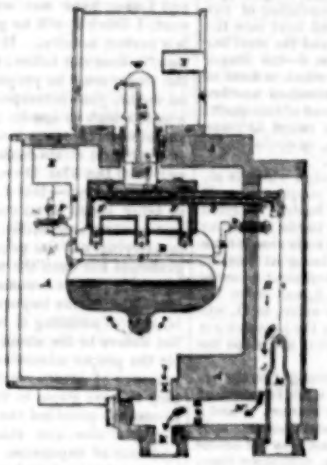

Fig. 2.—Section from the front to the back of the meter.

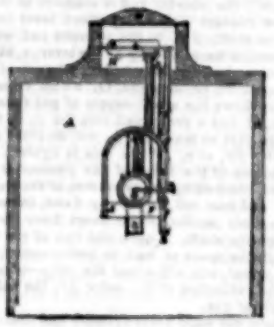

Fig. 3.—Plan of portion of the upper part, showing the pyrometer.

Fig. 4.—Section of the projection at the back of the meter.

Fig. 5.—Front view of the meter in an ornamental case.

To those familiar with gas operations in general, there is no occasion to enlarge on the advantages of a *good dry meter*. It has been a *desideratum* ever since the use of a meter at all was first duly appreciated, and has attracted the attention of many scientific and practical men, who have bestowed their ingenuity, their time, and their money in attempting to realise this desirable object; but so often in vain, that their repeated failures have impressed some short-sighted persons with an idea—which they have attempted to promulgate as an axiom—that a dry gas-meter was an object as unattainable as perpetual motion, or the philosophers' stone.

Gas-light companies have long had reason to wish for some other than a *water* meter. It is notorious that much of the time of their officers is occupied in attending to and in remedying complaints about the derangement of these instruments. From a variety of causes, also, a general distrust has recently arisen, in the minds of the public in general, against the water meter; though it is no more than a matter of justice to repudiate, in the strongest manner, the many aspersions thrown upon gas-light companies, among which *fraud* has been so unhesitatingly made the most prominent. Such misrepresentations are as absurd as they are unfounded, and only distract public attention from the real objections to the water-meter, which it is equally the interest and the desire of the companies to remove.

It is well known that *Mr. Clegg*, whose life has been passed in the study of the theory of gas-lighting, and in the practical application thereof on a large scale, is the original inventor of the present water-meter, most commonly known as *Crossley's*—a manufacturer who for many years possessed a monopoly of this business, by his purchase of the first patent-right. A variety of improvements have been suggested in the detail of the arrangements of the water-meter; but, speaking generally, none of any real importance, and no alterations whatever have been even hinted at, in the principle; indeed, after all, it must be admitted that the meters still made by Crossley are quite equal to any of those which have latterly been brought more conspicuously forward, and made the subject of a number of minor patents.

Independent of the complaints of the public and the disputes between the consumers and the gas companies, as to the degree of accuracy in registration, there exists, however, an inherent and radical defect in the present meter, from the necessary presence of water, as gas-engineers are well aware—for causes of deterioration and disarrangement arise from the very circumstance of the gas having to pass through water at all, which can never be remedied, and which must always give rise to complaints, wholly irrespective of the anomalies and irregularities in registration by a water meter, many of which appear to be perfectly inexplicable.

Of all this, Mr. Clegg himself was fully sensible from the first; and it is known to many men of science, and especially to those connected with the earliest of our gas establishments, that there is scarcely any —probably, not one—of the plans for *dry* gas meters, recently brought forward as new inventions, and which have been so prominently set before the public, which had not been tried, more than twenty years ago, by Mr. Clegg, and found wanting in some way or another, and, consequently, rejected by him; and it was only after repeated failures at that time that he abandoned, for a season, all idea of a *dry* gas-meter, and adopted what is now the ordinary water meter. The great difficulty since the original introduction of that apparatus to the present time, and which the proprietors of the patent sealed under Mr. Clegg's specifications had first to contend with, was to induce consumers of gas to use a meter at all. These prejudices have long been overcome in many of the large provincial towns in England; but particularly so in Scotland—for, in Edinburgh, Glasgow, &c., almost every house, and nearly every flat (*Anglice* floor), has its meter. In London, however, the meter is far from being general; and it is only just beginning to be introduced into Dublin, and the large towns of Ireland. Still the importance of using gas by meter continues to be better appreciated, and, as gas-lighting in private dwelling-houses comes to be more generally applied and better ascertained, the meter must be still more extensively introduced; yet, as the use of the instrument increases, its practical inconveniences are more known; and, at this time—added to the late public alarm respecting water meters—really in no small degree militate, and will continue to militate, against the use of the *makeage* of gas.

It, therefore, becomes daily more and more an object with all interested in gas, either as vendors or as consumers, to secure a good unerring meter, subject to as few derangements as possible, and the general accuracy whereof may be depended upon to a greater extent than any of the existing apparatus. This will, doubtless, be deemed quite a sufficient justification for an experienced engineer as Mr. Clegg to present himself before the public as the inventor of an instrument which he considers likely to realise what appears to be so much required.

It is some time since there occurred to this gentleman the original and happy idea of what he styles the "*Differential Dry Gas-light Meter*;" but, although he made great advances in practically applying the principle, the first machines, as is generally the case, were complex, and by far too expensive for general adoption in this country—though many of the instruments, constructed under his original patent, have since been working remarkably well, on the continent. The present extreme simplifications of the first plan form the subject of his second and recent patent, and which it is the purpose of the present paper to describe.

The construction and action of this meter are based upon the established facts, that the *heat and light* from the various kinds of carburetted hydrogen gas are *strictly proportionate to each other*; and, by the application of that fact, in combination with an apparatus, acting on the same principle as the differential thermometer of Leslie.*

By this apparatus will be measured most delicately the smallest differences of heat, and consequently the consumption of gas *will be registered in proportion to its illuminating power*.

Let two hollow glass cylinders, each about one inch in diameter and three inches long, be connected together in the centre of their lengths by a hollow bent tube of the same material—(being such as will be afterwards described, when treating of the mechanical arrangements for a six-light meter, and delineated in the accompanying figures). Let these cylinders and the connecting-tube be perfectly exhausted of air, and let as much alcohol be introduced as will nearly fill one cylinder, leaving a vacuum in the other—or, at least, leaving it without air, and with only such vapour therein as may arise from the alcohol. Now, as pure alcohol boils, *in vacuo*, at 56° of Fahrenheit's thermometer, the smallest excess of heat above this temperature applied to the cylinder having the alcohol therein will cause the liquid to evaporate, and, by its consequent elasticity, will drive the spirit below the vapour into the colder cylinder; and the velocity with which the alcohol will be driven out from one cylinder to the other will be in exact proportion to the *quantity of heat* applied—twice or three times the cause producing twice or three times the effect, and so on.—*For*, let air or gas be heated to a uniform temperature (say to 150° of Fahrenheit), and, when so heated, let it be directed to impinge upon one of two glass cylinders (such as those above described) with any given velocity: if this velocity be doubled, then double the quantity (or volume or body) of heat will be passed, and, consequently, double the effect (that is double the velocity with which the alcohol is driven) must be produced, such being an unerring and natural law. Although twice the *effect* be thus produced, the *temperature* of the air or gas has not been increased; it is only the flow, or *quantity*, which has been augmented; and this must be what is to be understood by *quantity of heat*. The best criterion of the soundness of the above statement is, that these facts have been determined from, and are founded upon, repeated and concurring experiments—the only true source of philosophical induction.

Such, then, being established, it became a leading principle; and the next step was to ascertain, by further experiments, how to apply this scientific fact to the art of *measuring the quantity of heat*, applied to one of the above described glass cylinders, and of registering the same; for this being accomplished, there was at once obtained an apparatus, whereby may be determined the exact flow of air or gas in a given time; in other words, a *gas-light meter*—such as the present instrument. The first consideration, therefore, was, *how to heat a given quantity of gas to a certain uniform temperature*, for, the gas being thus heated, and allowed to flow out at a given velocity, a *uniform flow of heat* was obtained.

Now, for the purposes of measuring this flow of heat, in the instance of a *gas meter*, the source of heat is present in the inflammable gas itself; and, after numerous experiments, it was fully and conclusively ascertained that a jet of gas, issuing out of an orifice, perforated in the side of a small solid brass cylinder (such as will be afterwards described, and shown in the annexed figures), will heat the said cylinder to a uniform given temperature, *whatever be the height of the said jet*; for, with a small flame, the jet clings, as it were, and is in immediate contact with the solid cylinder; whereas, when the flame issues from the orifice with considerable velocity, *still the longer jet only imparts the same degree of heat to the solid cylinder, as did the smaller one*; the increased (or lengthened) flame being, in this latter case, driven away from any closer contact, by its own velocity, or, rather, by the velocity due to the pressure of the gas issuing from the orifice. This fact having been thoroughly established by repeated experiments and practice, the necessary apparatus of the gas-meter, for the practical application of the fact, became very simple.

The next point expedient to be determined accurately, was the proper superficies of a receptacle, to be heated by or from such a solid cylinder as the one just described; which surface would be sufficient to communicate the requisite heat to such portion of the whole quantity of gas to be measured, as it was necessary to pass through the receptacle, without altering the temperature thereof to any perceptible degree. This point was ascertained, as the preceding ones were, by repeated experiments; and, further, it was found advisable that the receptacle for heating the gas should be well clothed with the best non-conducting substance, to keep it at a proper temperature.—The proportionate surface of the receptacle having been determined, certain other proportions and dimensions were established, which, as applicable to a six-light meter, are given in the figures accompanying the subsequent mechanical description, &c.

Lastly, it remained to be found what quantity of gas, heated in the manner previously described, and discharged upon one of two such glass cylinders, as before mentioned, would be sufficient to expel the alcohol therefrom, and drive it into the other cylinder. Numerous experiments, and long practice, have determined this quantity to be no more than *about one-seventh part* of the whole gas requisite to supply the number of burners—the consumption whereof is to be measured.

This being conclusively established, led to the consequent arrangement of *dividing the flow of gas*, as supplied from the main, so as to pass them separately through *two openings*, one of which should have its area six times that of the other, whereby *six-sevenths* of the gas admitted from the main might flow towards the burners without passing through the working part of the meter, leaving the remaining, or *one-seventh*, part, to perform the necessary functions of registering the amount of the whole quantity. The simple manner in which this arrangement is carried into effect, is duly pointed out by the figures, and is described in the subsequent explanation of the whole of the mechanical contrivances for the proper working of the meter.

Two openings, exposed to the stream of the same volume of air or gas, however they may differ in their respective areas, will always admit quantities thereof strictly proportionate to those areas. Thus, through a circular aperture of one inch in diameter, will pass precisely *sixty-four times as much* air or gas as through a circular aperture of only *one-eighth of an inch* in diameter; and this will hold unerringly, and under all pressures, allowing only for the additional friction the gas is exposed to in passing through the smaller opening, compared to its friction through the larger one. This theory is so well authenticated by practice, that it can require no further illustration here. It is only the smaller quantity, therefore, or *one-seventh part*, of the gas which it is necessary actually to pass through the working and registering parts of the meter; and, from this portion being very dry, and at a high temperature, an immense advantage is derived; *for*, as the decomposing action on the materials of the meter ceases when the gas is hot and dry, there will be little or none of that wear and tear, going on so rapidly in the ordinary water meter, from the *ammonia*, *sulphur*, and *galvanic action*, which are the principal agents of deterioration, and which also act (though not to the same extent) upon other dry meters, only exposed to the usual aqueous vapour which gas absorbs at the ordinary temperature of the atmosphere. In hot dry gas *the galvanic action ceases*; the *ammonia*, which exists in the form of a gas, will, when not exposed to aqueous vapour, *pass off harmless*; but, where there is moisture present, the ammoniacal gas is instantly absorbed, and becomes a strong alkaline solution, acting on the *wrought-iron* parts of the meter.

From Sir H. Davy's early experiments, it appears that (taking weight) 100 grains of water absorb thirty-four grains of ammoniacal gas, consequently (taking bulk) *one cubic inch of water takes up* 475 *cubic inches of that gas*.—(*See* Henry's *Chemistry*, Vol. I., p. 307. Third edition.) The *sulphur* in the gas, combining with hydrogen, forms sulphuretted-hydrogen gas. *Water absorbs twice its own bulk of this gas* (*See* the same work), and, when so impregnated, the gas is very destructive to brass and copper; *but*, when *dry*, *it is harmless*.

It will be observed that, in the dry meter now describing, all those parts which are exposed to six-sevenths of the whole quantity of gas admitted, consist either of *cast-iron*, *pure tin*, or German silver, none of which materials are acted on injuriously by gas, in the usual state of the atmosphere; and, *as there is no water*, and the remaining (only one-seventh) part of the gas working through the meter at a high temperature, the action of decomposition on the materials is altogether avoided.

All these requisites having been most conclusively determined *à priori*, it may be proceeded to consider the arrangements necessary to put the above philosophical facts to practical application in the construction of the New "*Differential Dry Gas-light Meter*."

First, the two glass cylinders, as previously described, are to be suspended in such a manner that the alcohol may be expelled *from* the *one* cylinder, placed in the lowest position, and driven to occupy the *other* cylinder, placed in a higher position; this being effected, the upper cylinder will descend and *act as a pendulum*, imparting motion with a power equal to the weight and height of the fluid raised. To ensure, however, the proper pendulous motion, it is necessary to attach a counterbalance to the weight of the glass cylinders and their connecting tube; this is further required, *for* the purpose of regulating the quantity of alcohol to be driven into the upper cylinder. The descent of this cylinder constitutes *one* vibration—the counter weight giving it such sufficient *preponderance*, or *momentum*, in its descent, as to cause it to impart motion, *with certainty*, to a train of wheel work, revolving in the way usual in gas-meters; and the vibration, and, consequently, the corresponding consumption of gas (*or* light), thereby becomes registered. The manner of suspending the glass cylinders, and fixing the counterbalance weight, is hereafter described.

The next considerations are—first, How is the tube, or receptacle, before-mentioned (and which will be called the "*heater*"), to be placed over the *lower cylinder*, so that, in discharging therefrom the hot gas, it may not communicate any of its heat to the *upper one*? and, second, How to place the *upper cylinder* in a medium always at the same temperature as that of the room in which the meter is to work?—it being absolutely necessary to keep the two cylinders at two greatly opposite temperatures, that shall always bear the same *relative degree or difference* to each other.

The first of these objects is arrived at easily, by placing a tin plate between the two cylinders, as is clearly shown in the figures, and pointed out in the mechanical description following. The second necessary effect is attained by enclosing the whole meter in a thick cast-iron case; in the interior of which, and forming parts of the same casting, two semi-cylindrical projections, or *bands*, are so placed as nearly to surround that glass cylinder which alternately becomes the uppermost one. The conducting power of this mass of iron is amply sufficient to carry off all the heat *radiating from the case of the heater* (this heater being, as before stated, enveloped in a case, or clothing, of the best non-conducting material); and not *only* so to radiate this heat, but to be always of the same temperature as the room in which the meter is placed. These *bands*, therefore, constitute a very essential part of the apparatus; for, if the temperature of the *upper* glass cylinder were to vary materially, as would that of the lower one, and, consequently, the rate of the meter would also vary; but, by this very simple contrivance, the temperature of the heater, and that of the *lower* glass cylinder, will be always of the same relative temperature to that of the *upper* cylinder.

Take an example:—Let the "*heater*" be at 150° of Fahrenheit, and the room—and, therefore, the cast-iron parts of the meter—at 60°, then the gas which flows from the heater on to the *lower* glass cylinder will be at the same temperature—viz., at 150°, and thus the moving power (originating from the meter jet) will be equal to 90°, which *represents* the heat imparted by the meter jet—each being a constant and uniform quantity. If the temperature of the apartment, and, consequently, that of the iron case, bands, &c., be raised to 80°, the temperature of the heater will be increased 20°—becoming 170°—the moving power being constantly 90°. It has been deemed necessary to dwell particularly on this part of the arrangement, which is absolutely essential to the correct registration of the meter, and which has been con-

* The common "*pulse-glass*," exhibited in the shops of opticians, is a similar instrument.

ived in so complete and effective a manner, and by means which cannot possibly be deranged.

The preceding are the leading features of this philosophical arrangement for measuring the flow of gas of a given quality. With *the same heat the same results will obtain*—the only variation that can take place must be by the change of temperature of the small jet of flame, which issues from the bemispherical end of the solid brass exhibition—this being the governing principle; consequently, with no increased temperature of the solid brass knob, caused by a brighter flame (and which imparts its heat to the tube, or receptacle for the gas, called the heater), or vice versa (the same quantity of heated gas being discharged on the lower glass cylinder), the flow of alcohol from the one cylinder to the other, and, consequently, the vibrations will be quicker or slower in exact proportion to the *difference* of temperature. Hereby is obtained a measure of light; in fact, a *photometer*—that is, a *light meter*; in other words, a gas *light* meter, rather than *gas meter*, which is the more accurate definition, since the article to be measured is *light*, not gas; for it is well known that *the illuminating power of coal gas varies 30 per cent.*, according to the process used in its production, and the quality of the coal from which the gas is obtained.

The principle of this meter being based on the fact, that the intensity of the heat from a gas flame is as the brightness or illuminating power, it may be well, for the information of those who have not made this branch of chemistry their study, to give the following short extracts from the most approved authorities:—

From Dr. Henry's Experiments on Coal Gas, published in the *Manchester Philosophical Transactions*:—

"By the first train of experiments, I endeavoured to derive, from a careful analysis of the compound combustible gases, a measure of their illuminating power, as the most correct expectation than the optical method of a comparison of shadows. The one which I was led to prepare, as the most accurate, and, I still think, entitled to preference, was the determination of the quantities of oxygen gas consumed, and of carbonic acid formed by the combustion of equal measures of the different inflammable gases—that gas having the greatest illuminating power which, in a given volume, occasions the largest quantity of oxygen. The average results of a great variety of experiments were comprised in the following table:—

Kinds of gas.	Oxygen gas required to saturate 100 measures.	Carbonic acid produced.
Pure hydrogen	50	—
Gas from moist charcoal	60	35
Ditto from wood (oak)	84	43
Ditto from dried peat	96	100
Ditto from cannel coal	174	124
Ditto from lamp oil	190	137
Ditto from wax	220	179."
Olefiant	284	

From the preceding, it is clearly proved that the illuminating power of gas depends upon the quantity of oxygen consumed, and of carbonic acid produced during combustion.

The object of Dr. Henry's paper was only to prove the illuminating power of the gas; in order, therefore, to prove that the heat from the combustion of any gas increases in the direct ratio of the oxygen consumed, the following is extracted from Prof. Graham's *Treatise on Chemistry*:—

"From the late researches of Dulong and of Bull, a very interesting rule has been obtained, it is as follows:—'That in all cases of combustion the quantity of heat evolved is proportional to the quantity of oxygen which enters into combination.'"

And in Henry's *Chemistry*, ninth edition, p. 422, we find it stated, that, "*by the combustion of denser gases, a higher temperature is produced.*"—*See* also Williams *On Combustion*.

The *heat and light from the gas having been thus demonstrated to be proportionate to each other*, we have, in the preceding apparatus, a meter which will measure the quantity of light given forth, which is the real end to be desired, and the following description of the *mechanical arrangements* may be now proceeded with:—

Figures 1, 2, 3, 4, 5, represent different parts and positions of "*Clegg's Patent Differential Dry Gas light Meter.*" They are drawn to a scale of 3-10ths of an inch to one inch, or in that proportion to a full sized meter, capable of measuring the consumption by six large gas-light burners—that is, a "*six light meter.*" The same letters refer to the same parts in all the figures.

A A A is a cylindrical cast-iron vessel, being the *case of the meter*, of about a quarter of an inch thickness of metal (made thicker at particular parts requiring it), and five inches outside diameter. P P are bands, or projections, parts of the same casting of the entire case or vessel—the important functions of which have been previously explained. The references to the working parts, distinguished by the other letters, will be made in the subsequent explanations.

For the sake of distinctness and simplicity of description, it may be best to show, first, the manner in which the gas flows through the vessel, and the action of all those parts which are essential to the mere meter—taking up afterwards certain auxiliary mechanical contrivances, quite independent of the general principles on which the meter is constructed, or of the actual operation of registering the light—those contrivances being chiefly introduced for preventing frauds.

When the gas is first turned on at the main stop-cock, it flows into the meter through the openings, or pipes, M, to the valve, O (hereafter will be described the use and action of this valve), which opens into a vertical passage at the back of the meter. Along the upper part, H, of this passage flows a small portion only (viz., one-seventh of the whole), gas finding its way into a receptacle called the "*heater*," into which it enters through the pipe, at I, and thence fills every part of the main body of the meter, where the working parts are disposed; the direction of this flow, or current, of gas is indicated by short light arrows along its entire course. The remaining larger portion (viz., six-sevenths) of the gas flows down the lower part, J, of the above vertical passage at the back, and along the horizontal tube, N, at the bottom of the meter, and through the regulating disc, or opening, E, fixed therein, and thence passes direct towards the burners, through the main exit, K. The area of this disc, E, is exactly six times that of the opening, I, into the heater and working parts of the apparatus. This larger portion of gas flows through these lower passages of the meter, without influencing any of the working parts, and, for that reason, is called the "*Neutral Gas*." The smaller portion of the whole supply may be called the "*Working Gas*." A minute quantity of this gas flows from the body of the meter through the small openings, *b b*, permanted to a solid brass cylinder, G, entering at the bottom, where this cylinder is screwed on to the top part of the heater, F, and issuing out in the front of the cylinder near its top, in a jet, at *c*; this is called the "*meter jet*," and forms an important part of the arrangement; it may, indeed, be designated as the originator of the moving power—in fact, the prime mover of the meter. The orifice, whence issues the meter jet, at *c*, is plugged with platina to prevent corrosion, or any other wear and tear. This meter jet, immediately after opening the main stop-cock, should be lighted, that it may at once impart a corresponding amount of calorie to the heater, and thereby raise the "*working gas*," flowing through that receptacle, to the same temperature. This receptacle, with the connecting pipes and the brass cylinder, may be considered as forming one apparatus, under the general designation of the "*heater*," or, in a pasteboard covering for the heater, and all the parts connected therewith, except the metal brass cylinder —pasteboard being selected as the slowest conducting substance wherewith to surround them.

The working gas, raised to a high temperature, flows down from the heater through the vertical pipes, I, I, I, and impinges on the top surface of the lowest one of two hollow glass cylinders, B B. These cylinders are connected together in the centre of their lengths by the brat hollow glass tube, C—the whole being cohesated of air, and partially filled with alcohol, as described in the commencement of this paper. A tin collar, S, is attached to the heat tube, C, and to a large tin plate, D', passing between the two glass cylinders; this plate unites to brass screws, or bars, H H, on each side, and by those the whole glass instrument vibrates on pivots, or points of suspension, at the extremities, D D, of two screws—one passed through the side of the centre of the lower cylinder, and the other sustained from the head iron bracket, seen over of the meter, and the other sustained from the head iron bracket, or arm, F, attached to one of the brass bars, H, to act as a counterbalance to the upper end of one of the two brass bars, H, to act as a counterbalance to the vacuum, and for the purposes previously described—the pendulous motion thus obtained acting on the main of whatsoever of the registering dials.

The use of the tin plate, D', passing between the two glass cylinders, is to prevent any of the heated gas flowing down upon the lower cylinder from affecting the upper one, and thereby altering the proportionate difference of temperature between the two cylinders, which forms the basis of the principle on which the vibrations are kept up. The "*working gas*," after acting on the lower cylinder, as above described, flows down through the main body of the meter, and along the outlet at the bottom, where it re-unites with the "*neutral gas*," passing through the regulating disc, E, and with it passes to the gas-consumer, K, towards the burners.

This, then, is the description of the whole of the mere meter, and it will be evident that no alteration in the measure can, at any time, take place by the leakage of valves, there not being any in the working parts, neither is there any membrane or partition, that when such become acted upon, and crushed or pierced by the action of the gas, any portion can escape through them unmeasured; the moving power being the small light at the top (the "*meter jet*"), it will likewise be apparent that there is not the least condition to the flow of the gas, and that that the gas passes through every part of the meter in the same unhampered way it would flow through a pipe, or other transferring will; the perfect steadiness of the lights, our requiring any pressure.

The remaining mechanical contrivances are the stopping of the gas from the heater when the meter jet is not lighted—the giving a temporary extra lighted on the heater, for a few minutes only, when the meter jet is first lighted—and for the regulation of that jet (when the meter is originally fixed in its place), according to the pressure; the whole contrivances being chiefly, as before observed, for preventing fraud, and ensuring proper registration.

For this purpose, it is first necessary that the small light, or "*meter jet*," should be so guarded that it cannot be interfered with, and that the gas can only be obtained by the consumer until it is, and while it continues to be, lighted. In figures 1 and 2, Q Q represents the frame of, U, the base or seat for, and W, the brass wire gauze of, a cylindrical case or covering, inclosing the meter jet; the front of this case is covered by a plate of ground glass (which may be made ornamental, if required), and the back is secured by a tin plate; into the interior of this covering there is no entrance, except for the air through the wire gauze, and through a tin tube, or pipe, Y, at the back, affording only the means of lighting the meter jet, or of taking a light from it. An adjusting screw, *n*, in the solid brass cylinder, G, is placed to regulate the supply to the meter jet, according to the relative pressure of the gas (at each place where a meter may be fixed), with respect to the general pressure upon the gasometer at the gas works. The regulation of this supply, which is adjusted at the time the *meter* is put up, is solely with a view of preventing any unnecessary consumption of gas, or extra height of flame at the meter jet (especially when this is not required, as a light at the place where the meter is fixed); for, as has been previously stated, experiment has clearly demonstrated that the *degree of pressure* or height of this flame has no effect in altering the temperature communicated by the *meter jet* to the *heater*.

To prevent the gas flowing to the burners, except when the meter jet is lighted, and the meter registering accordingly, there is the following simple contrivance:—In figures 1, 2, and 3, *a a* is a pyrometer, consisting of one flat bar of brass, and another of steel, soldered together, and bent into the form of the letter U, one end being longer than the other, and the steel bar on the outside; the shorter end is soldered to the heater, at *d*—the longer one is in close contact with a very short lever (or cam), *e*, which is fixed to one end of the shaft, *f f*, to the opposite end whereof is attached another lever, *h*, about ten times as long as the lever, *e*, at the other end of this shaft; at the extreme end of this long lever a wire, *o*, of the metal called German silver, reaches down to the valve, O, which closes the pipe, or opening, M, through which flows the whole supply of gas from the main.

This valve, O, has a very small nick (at *p*, in fig. 4), through which is allowed to ooze just so much gas as will do little more than supply the small flame, or *meter jet*, at *c*. When this is lighted, and the "*heater*" is acted on, the expansion of the brass of the pyrometer (attached to the heater, as just described), exceeding the expansion of the iron, the two ends recede from each other; and one end only being fixed, the other end, being at liberty, moves; this gives motion to the short lever (or cam), *e*, sufficient to make it act through the shaft, *f*, upon the end of the long lever, *h*, and move the latter through the space of half an inch—consequently, the valve, at O, will rise to that extent, and will admit the gas;—of course, when the pyrometer is cooled, by the extinction of the *meter jet*, the valve, O, closes, and stops the further supply of gas.

In order that the solid brass cylinder and heater may be brought to the requisite temperature as quickly as possible, an extra flame is made to surround the lower part of the brass cylinder temporarily, issuing out between it and a thin steel cylinder, *h h*, concentric with the solid one; this extra flame not only heats the requisite parts rapidly, but gives an extra temperature to the heater for a few minutes, causing the meter to go quicker during that short time, thereby making up for what was lost in starting. When this concentric flame has been lighted about five minutes, it is extinguished by the rising of the same lever that opens the valve, O. The gas which supplies this extra concentric flame, flows through the small pipe, *i i*, one end of which is connected with the socket in the upper part of the heater, where the brass cylinder is screwed thereto, the other end of the pipe projecting just over the long lever, *h*. From the pipe, *i*, the gas flows through the openings, *g g*, in the solid brass cylinder, and issues out between this cylinder and the thin steel concentric cylinder, *h h*. At the return or head of the pipe, *i*, is a minute opening, through which the gas enters the pipe, but which is closed by a small piece of cork, fastened to the long lever, at *i*, which lever, by its rising, as before described, closes this minute opening into the pipe, *i*, against the further admission of gas, and thereby extinguishes the concentric flame. This movement for regulating the supply of gas for the extra flame comes likewise into operation, when, from any cause, the meter jet is so far reduced as to prevent its imparting the requisite temperature to the heater. By the above-described arrangements, all possibility of fraud is prevented, as no supply of gas will flow to the burners, *except when the "heater" is raised and kept to the proper temperature*, by the regular burning of the meter jet.

The case of the meter may be made handsome and decorated, so that the apparatus will have some resemblance to a time-piece, as shown in one of the accompanying figures. This case may be varied, according as taste or expense may regulate. In its most simple cover, it will appear rather ornamental than otherwise, and may be fixed in a passage, hall, office, counting-house, living-room, or in any convenient situation of a public or private establishment, and so as to be as open to observation as a clock or a barometer.

It must be observed, that in working out the preceding theory to practical operation, it cannot be supposed possible to carry out the same as unerringly as in Nature; the best materials and the best workmanship will not produce it. Were all the materials and workmanship perfect, and the pressure of the gas uniform, we should obtain the most correct chronometer on record. But as an average can be, and is, attained, which brings out a result sufficiently accurate for all practical purpose, and *for continued or periodical registration, more accurate than any other meter yet constructed.*

In obtaining the pendulous motion, although the same quantity of heated gas is discharged on each of the *lower* glass cylinders alternately, and each upper cylinder rests in the same medium of temperature, still we cannot, in practice, make them both vibrate in the same *absolute* time, though the periods of the *double vibration* are always very nearly alike. The smallest variation in the quality and thickness of the glass of the two cylinders will make a slight difference, though it is really wonderful to consider the extreme accuracy in this respect which the manufacturer of them has attained in procuring which the manufacturer of them has attained in procuring the same. The *balance-weight*, giving momentum to the *upper* cylinder, being more on one side than the other, or a deviation even, of the points on which the cylinders vibrate, will make a trifling difference; and the smallest variation of the centre of motion will alter the time of oscillation, *considered chronometrically*—in fact, were it not for those mechanical niceties, a meter might be made at once unerringly, and without trial. But, as these niceties are requisite to be attended to, the practice of the manufacturer and workmen will have to secure the greatest possible perfection, and, under any circumstances, each meter will be tried and tested before being sent out. Even then it may be supposed that some mechanical deficiency, *from theoretical perfection*, will sometimes attach to each meter; in practice and in testing, therefore, an average, not only of a double vibration, must be taken, but also of *a number of double vibrations*, for a given number of cubic feet of gas consumed; and, in comparing this meter with any of the present water meters, or any other dry meter, the gas should be passed through *at least* two of them, and the mean taken. The average of a number of double vibrations of the meter will *bring out a true mean*, accurate within a very *small fraction*—*far* more so, indeed, than can be practicably attainable by measuring inflammable gas in bulk; for bulk is constantly altering, by variations of temperature, by the presence of more or less aqueous vapour, by differences of pressure, and by admixtures of different kinds; so that, in fact, we do not know what is measured, when it is attempted to measure gas by bulk. In measuring it by a certain *heat*, neither variations in the external temperature, or in the pressure, affect it, whilst the quality is accurately ascertained, *a test quality correspondent* with the deduction of the quantity of aqueous vapour, of atmospheric air, or of any other of the innumerable gases which may be contained in the gas to be registered, for a meter on this principle (of measuring by a certain heat) *considers only the quantity of the combustible gases*, and does so *accurately*, *at any temperature*, or at any pressure, *to which the gas is exposed*. To doubt that the same results which have been ascertained to take place from the same cause, will not always take place under the same circumstances, is to doubt any other operation of Nature. No one doubts, when he puts a fire under a boiler containing water, but that a certain quantity of steam will be produced with a given quantity of coal consumed (according to the heating qualities of that coal), and that the quantity of steam so produced will do a certain work when applied to an engine. Does any one doubt that a given extra heat will not always expand air to a given bulk, or move a pyrometer to a known point? With *familiar* natural operations, there is neither doubt or uncertainty; exactly, familiar as every day occurrences.

Perhaps, it may be the most conclusive remark, in respect to the application of this easily beautiful theory to practical purposes, if it be observed that there are now in Paris nearly 1000 meters on this principle working in an extremely satisfactory manner, as is well known to those scientific men who have had opportunities of hearing the report of Mr. Wilson, the talented engineer of the Paris Gas Works. These meters are vastly more complicated and expensive than the one just described, having been made under Mr. Clegg's first patent; the improvements forming the subject matter of the second patent have simplified all the arrangements, thereby combining every ounce of economy in action, and also making the apparatus to be made at a cost much less than half of a good water meter of corresponding measuring capacities.

ORIGINAL CORRESPONDENCE.

MR. SIMS'S IMPROVEMENTS ON THE STEAM-ENGINE.

TO THE EDITOR OF THE MINING JOURNAL.

SIR,—When I sent you the diagram and explanation of my improved engine, I very naturally supposed that somebody would, as with every other invention, show their teeth to it; but, as I have had several at work in this county for some time (the pumping-engine at Carn Brea more than three years), I had no idea that my neighbour or neighbours would, after such lapse of time, bite with such apparent spirit of animosity, revenge, and ignorance, as is displayed in your paper of this week. The letter of "A Young Engineer," last week, was mild and respectable, merely asking a civil question, but this comes with such violence—and, no doubt, in the writer's opinion, settling and confirming every point as it goes along—that I have no doubt he was highly gratified at the production, and fully confirmed, in his opinion, that he had stopped all further attempts at the introduction of the combined cylinder steam-engine, and established a fact, that the Bolton and Watt engine is at the *ne plus ultra*. I beg to congratulate him on his profound scientific knowledge, as, no doubt, it will be the means of preventing many sleepless nights, and expensive experiments and patents, in attempts to make any further improvements in the steam-engine—of course, the writer supposed it impossible to confute anything he has there laid down; but, however, he may be disappointed. I shall make the attempt. I am very sorry that my friends, Messrs. Hocking and Loam, have met with no better champion—better write themselves next, I think it will be garnished with less ignorance. The first remark is a perfect novelty. It is as follows:—"With regard to the first objection, it does not follow, that, in order to insure a high rate of expansion, the steam must be proportionably high in the boiler (very important), as, no doubt, your correspondent has discovered a new property in steam, that whether high or low its expansive property is the same." The large valves and steam pipes was a recommendation of mine, given in a public lecture at Truro, on steam-boiler explosions, and appeared in the *Mechanics' Magazine* of the 21st December, 1839, and several other publications. It was as follows:—But I fear the greater number have exploded by means of using steam of an unnecessary pressure, and, in order to render this fact as clear as possible, I beg to remark here, that the Cornish engineers, in carrying out the principle of working steam expansively, and which principle has been the means of causing the Cornish engines to exceed all others in point of economy of fuel—I say they have (myself amongst them) lost sight of one important feature in this principle of expansion, which is, that of omitting to have the apertures for the admission of steam from the boilers to the steam cylinder of a proper size, or of a size large enough for the proper admission of steam, in proportion to the load of engine and pressure of steam required. The consequence is, that it is found necessary to have steam in the boiler of a much higher pressure than would be necessary, provided the aperture from the boilers to the cylinders had been a proper size, and this is in a ratio proportionate to the load of engine and rate of expansion. This important feature in the steam-engine has been so far neglected, that I have known a 7 inch aperture *only* used for the admission of steam on a 70-inch piston. The area of the 70-inch piston being upwards of 100 times as much as the area of aperture, or valve, for the admission of steam, it becomes a natural inference, that so small an aperture could not possibly supply one-third of such large cylinder in about a second. I mention one-third of the cylinder, because that is about the average distance which the pistons do descend before the steam from the boiler is cut off, the remaining part of the stroke being performed by expansibility of the steam which entered the cylinder for that one-third of stroke. The consequence of having such small apertures is, that it is found necessary to have steam in the boilers of a pressure very much above what would be necessary, provided the steam pipes and steam valve had been of a proper size; and this inconvenience becoming more as the load of engine increases, I fear that explosions of the worst character have taken place in consequence.

Comparing the date of my recommendation with the time Taylor's engine, at the United Mines, was put to work, it will be found that the engine has been erected long since. Trevithick's and Woolf's boilers, for the 100 lbs. pressure steam, was made of a strength in proportion to the pressure of steam used by them, and what is used in the present day. Your correspondent's next question is really a disgrace to any one professing to be an engineer, and more especially a Cornish engineer. He says —"But, supposing steam of a much higher pressure than any now used in this county to be used, would Mr. Sims, or any other engineer, anticipate explosions on that account?" Having, in my long practice, been a witness to so many fatal explosions, and having seen the dire effects of so many which I did not witness, I am obliged to inform your very philosophic correspondent, that I really should anticipate explosions on that account. Your correspondent had better reverse the question—then he will have all the engineers to agree with him, not otherwise. The next assertion I hope is nothing more than the effects of a dream having left a strong impression on a weak mind, which could not be easily eradicated. He says it would be easy to show, if necessary, that high steam has little or nothing to do with explosions. In future, we may, of course, have our boilers made with even iron, or tin-plate, and of what form we like. Your correspondent had better obtain a patent for this important discovery. I should be very glad if your correspondent was correct relative to the danger existing only in my imagination. I sincerely wish it was so, but I am sorry to say that I have seen many lamentable proofs to the contrary. The next is a more reasonable question, but will only hold good in theory. It must be evident to every one acquainted with the steam-engine, but more particularly mining engines, that they are subject to an increase of load as the boilers and other materials become weaker by age—and, consequently, wear—and, when economy is most wanted, by using the expensive principle, we are deprived of the benefit of using it. I am prepared to prove, that there is no additional expense in my engine, in proportion to the power. Provided your correspondent is correct in calling a 50-inch equal to the power of a 70-inch engine Bolton and Watt (this is quite as much as I have hitherto given it credit for), I will be glad to take an order from him for a 50-inch combined cylinder engine, complete, for less money than I would furnish him with a 70-inch Bolton and Watt, and if he can fairly make the 70-inch Bolton and Watt perform so much work on the same quantity of coal, he shall have the 70 for nothing.

Now for the advantage, or disadvantage, of expanding steam in one cylinder of the same bore throughout, which I will endeavour to render as simple as possible. Suppose I have a 70 inch cylinder set to work on a mine, and, in consequence of the necessary increased depth of the mine and the unavoidable increase of water, that engine has so much to do, that the expansion principle is obliged to be dispensed with, and the cylinder receives a full supply of steam from the boiler at every stroke, equal to the pressure of the steam in the boiler, without which it cannot perform its work—here no expansion can be used. I will now place a 60-inch cylinder underneath this 70-inch, with its piston and rod attached to the other piston and rod; the effect will then be, that the steam, which was thrown away before, will be applied underneath the other piston, expend itself four times, and, according to your correspondent's own assertion, double the power of the engine—or, at least, as a 50-inch engine is to a 70, and this without more boilers, or, in fact, anything but the cylinder and appendages. Again, we are occasionally so situated as regards underlie shafts, working with horizontal rods, &c., that we dare not work expansive in one cylinder; the second cylinder here would have the same effect as above. Again, suppose an engine working with a load of 70 lbs. per square inch of piston, and raising a load of 100,000 lbs.; is it practicable to give the piston of this engine such an impetus, at the same time such violent concussion, as to drive the piston to the extent of stroke eleven or twelve feet, with no power of steam on that piston at the extent of stroke? This *would be working with a vacuum indeed*. Seeing the total impossibility of rendering this mode of working practicable, is it not better to have some mode of expanding with less violence, and at the same time making sure to use the full effective force of the steam; and does not the steam in this case, run double the length of stroke it does in the one cylinder, and affording a power as long as there is a power left in it? It is, in fact, if the engine is a 10-feet stroke, a 20-feet run of steam to do the work that your correspondent attempts to do in ten feet, and in the same time too. Again, I have a Bolton and Watt double power engine at work with a short stroke, too short to have the benefit of expansion to any extent. This engine having a very heavy load, I am obliged to work steam each way, as high as I can condense, if any higher, the injection would not meet it, consequently, would not condense; in this case, the cylinder filled twice with steam, is thrown away at every stroke—and course, in a 20-inch engine, working four feet stroke, twenty strokes per minute, there would be

a loss of 174 cubic feet of steam per minute. I will now take a combined cylinder engine, with top cylinder of same size; this engine takes the same pressure of steam from the boiler, and makes the down stroke. This steam, instead of being allowed to pass off to the condenser, expands itself four times, does as much work on the up-stroke as on the down-stroke, without an additional quantity of steam from the boiler; here (and which I am, at any time, prepared to prove) I have an engine of the same power as the Watt engine (or if less, only the friction of one piston) with half the quantity of steam. But, as I before said, not being able to condense higher steam with the Bolton and Watt engine, that power was limited. In the combined engine, the steam is reduced in the large cylinder, after having done its work in the small cylinder, to one quarter of its pressure, consequently, I can use steam in my engine of four times the pressure, and, as far as regards the pressure of steam, my engine is four times the power—this I am also prepared to prove. The indirect and complicated manner of expanding the steam spoken of by your correspondent, is, of course, a *startling objection*. There is no more complication about this engine than a Bolton and Watt, except a longer cylinder (for I have made them in one) or another cylinder and piston, and instead of the steam forming an equilibrium of pressure on the up-stroke, it goes under a larger piston, and if it does no good (as your correspondent has laboured so rashly to prove) it can do no harm. Your correspondent speaks of Taylor's engine, at the United Mines, having performed 107,000,000 lbs.; there are two more engines of the same size on these mines, erected by the same engineers, and performed, the same month, the one only 64,000,000 lbs., and the other 70,000,000 lbs.; and is it true, as I have been informed, that the new engine at Treavean, erected by the same engineers, same size as Taylor's engine, erected since that engine, and made by the same manufacturers, never has exceeded 60,000,000 lbs.? The second cylinder, or some other thing, is evidently wanted in these engines—*every tree is known by its fruits*; probably I should do better to compare my 50-inch combined engine with one of these, as it is merely an old 50-inch Bolton and Watt altered to this plan, some parts of which have been in use ever since 1824. It does not look exactly fair to compare this old engine with a new 85-inch engine, so new, and every part of the best quality. I had the management of this 50-inch in two mines, when it was a Bolton and Watt engine, the highest duty I could obtain, was 51,000,000 lbs., since the alteration, it has been 95,000,000 lbs. If this is not an improvement, my thirty years' experience has taught me to know nothing of steam-engines. Your correspondent is hard on me, when he compares the two engines, and says, "what a bold man." I might, as far as he knows, have had the report of March, 1841, staring me in the face; it stood thus:—

Taylor's engine.....	72,485,983 lbs.....	Hocking and Loam	
Sims' combined	86,298,577 „	*J. Sims.*	

According to my opponent's opinion, I have, by placing a 90-inch cylinder under an old 50-inch cylinder, without any other alteration more than I should have, by again fixing the engine as a 50-inch Bolton and Watt, obtained a power equal to a 70-inch engine; I have told my employers at the Carn Brea Mines just the same (never above that amount), and now the assertion, coming *from such respectable authority*, I rather think I shall be entitled to a vote of thanks. I have, in this case, done for about 500*l.*, what would cost more than three times that amount in a 70-inch engine; in this, and only in this, one thing, is your correspondent correct. I take this opportunity to call on this gentleman, my opponent, whoever he may be, with all his bad feeling towards me and my engine, to come forward and make a trial of the combined cylinder engine, either for pumping, winding, or stamping, or, in fact, any other purpose to which it has been applied, and, then, if he does not find everything I have stated to be correct to the letter, he shall have my consent to publish it to the world; until then, and not until then, can he be justified, nor will he receive much credit for such unwarrantable attacks as he has made on me.

Redruth, Feb. 27. JAMES SIMS.

NEW THEORY OF APPLYING STEAM TO AN ENGINE, WITH A NEW PROCESS OF EVAPORATION.

TO THE EDITOR OF THE MINING JOURNAL.

SIR,—With reference to my communications of the 12th November, 3d and 17th December, and 29th January, it will be observed, that I advanced an opinion, that there is a loss by condensation, and adduced Mr. D. Napier's closed condensers in proof of the assertion. Your correspondent, who took up the matter very warmly, seems now to avoid further discussion, and no one else has attempted to refute the statement. I shall now endeavour to show, that, besides the loss of power in working the condensing apparatus, from which there is no return, there is a further loss in the use of it, consequent on the obstruction it offers, in certain circumstances, to the steam on leaving the cylinder. I shall suppose two steam-boats, one with, and the other without, a condenser, and both the same size, and so proportioned, that, with 5 lbs. effective pressure on the piston, a speed of twelve miles per hour could be maintained, but for the steam-boiler being unable to furnish steam for more than *ten* miles per hour, as explained more fully in my letter of 12th November, it is necessary, when steam is effectively applied, with large pipes and valves to have an exit steam throttle, to prevent the speed of the engine overpowering the boiler. It would, therefore, appear, that the speed of the boats depend solely on the evaporative power of the boiler—that withdrawing the pressure of the atmosphere cannot add to the speed of the engine, it being necessary to apply a resistance by means of a steam exit throttle, to keep down the speed to the evaporative power of the boiler. Nor can the removal of the atmosphere at the exit add to the propelling power; for, if steam be effectively applied, it requires the same quantity to fill a cylinder, with or without a condenser—the pressure of steam on the piston is, therefore, the same in both cases. Suppose these two steam-boats exposed to bad weather, by which their speed is reduced from ten to five miles per hour, it is clear that the one with the condenser can derive no advantage from the vacuum, the resistance of the piston, in consequence of the weather, being not only superior to the atmospheric pressure, but even reducing the speed of the propelling power of 5 lbs. pressure from ten to five miles. It may be here remarked, that the atmospheric pressure resembles a steam exit throttle, being both self-acting drags, both cease to operate the moment that the resistance on the piston, consequent on the mass kept in motion, becomes a more powerful drag. Here are two steam-boats, retarded by bad weather; as condensation does not increase the pressure on the piston, but merely removes it at exit, it cannot increase speed, and there is no want of steam; for, in consequence of the reduced speed, from ten to five miles per hour, the boilers are not exerted to half their power; it is, therefore, either additional pressure, or an increased area of piston, that is wanted. By doubling the pressure, although the speed of the non-condensing engine would immediately increase, I would ask practical engineers, what would be the effect on the condensing-engine (calculated to condense steam at 5 lbs. pressure), when steam of 10 lbs., or double the quantity, requires to be condensed at every stroke of the piston? and, perhaps, the boiler so constructed, as to be imprudent to expose it to the extra pressure. In conclusion, I have no hesitation in saying, that there is not a steam-boat whose speed might not be very considerably increased, were the condenser abandoned, the steam pipes and valves enlarged, and means taken to improve the evaporative power of the boiler. The plan I recommended in your valuable Journal of 29th January would double, if not triple, evaporation, and the power at present wasted in working the air-pump might be applied to this process of evaporation.

GEORGE GOODLET.

Leith, March 6.

ON THE USE OF ANTHRACITE COAL.

TO THE EDITOR OF THE MINING JOURNAL.

SIR,—Permit me, through the medium of *your Journal*, to point out two reasons why the use of anthracite coal is a subject worthy the attention of Government:—1. Anthracite is not subject to spontaneous combustion, by which more than one vessel has been destroyed; a few years ago a Government steamer was destroyed in the Mediterranean from this cause. 2. Anthracite emitting no smoke, a steamer of war using anthracite fuel would discern the approach of an enemy using bituminous coal, from her smoke, two hours before her approach was visible to the enemy. It has been a great misfortune to the steam enterprises already entered into, that this cheapest and finest fuel has been disregarded. Loss of tonnage, by stowage of heavy and coarse fuel, is loss of profit.

March 6. J. H.

[We conceive that the great desiderata here have been supplied by the process described in our last, to which we refer our correspondent, and which is advertised in another column.]

REMEDIES FOR DISTRESS IN MINING AND OTHER DISTRICTS.

TO THE EDITOR OF THE MINING JOURNAL.

SIR,—In your paper of Saturday last appears a letter from "An Englishman," dated Tobago, Jan. 3, in which he is pleased to favourably notice some papers of mine relative to the employment of the superabundant population of the country: and it gives me much pleasure to perceive that "An Englishman," like a Roman of old, has next his heart the welfare of his "own dear native land," be he in whatever remote corner of the world he may: the gentleman alluded to, as well as yourself, Mr. Editor, in a note appended to the letter in question, would seem to call upon me for a more explicit avowal of the objects I have in view on the subject of finding "good and profitable employment for all people in want of the same:" and therefore, at your earliest convenience, will feel obliged by the insertion in your columns of this communication, in which I have condensed the affair into as small a space as possible, to permit at the same time of its being clearly understood; for, although the subject may appear not to be directly connected (although it positively would be) with mining and metallurgical pursuits,—yet I trust to your sagacity to perceive, that a project for securing, at all times, full employment for any excess of our population, must ultimately diffuse prosperity over not only mining, but manufacturing, commercial, banking, and all other pursuits of modern civilization; as such, therefore, I entreat your able aid in giving publicity to the views and intentions of myself and others, on the very momentous subject in question.

The *principle* upon which it is proposed to proceed, is, to put the unemployed of the land in a situation to maintain themselves, entirely by *their own labour and skill*; and thereby to permanently remove the present pressure in the *labour markets* of the country, and prevent in future all *cause* and *excuse* for pauperism, vagabondry, idleness, vice, and crime: and the *plans* are, to establish a series of *working benefit societies, or labour companies*, for the reception, under due rules and regulations of the parties above-mentioned. These "working societies," I have named "Samaritas," (particulars of which will be found in a small pamphlet under that title, recently published by W. Strange, 21, Paternoster-row, London). It is proposed to plan three or four of these "Samaritas," by way of trial of the new principle of action,—and ultimately to carry out the whole affair, by means of *private funds alone?* and which should be done, provided leave and licence can be obtained for so doing, under a *royal patent or charter*, for, say twenty-one years. Now, throughout the whole business there will be no interference made with the present laws and institutions of the land, either in Church or State, nor as concerns any individual, company, society, or party; neither will there be a single shilling of expense required without a due and satisfactory equivalent being returned to those individuals who may feel disposed to patronise this great and truly philanthropic affair,—an affair that will produce an incalculable amount of *good*,—without the least fear of *evil* to be apprehended, either in its action, or its consequences. This undertaking may justly be considered as the germ of an immense statistical discovery,—a discovery pregnant with consequences to mankind of equal—nay, indeed, of far greater importance than that of the invention of printing,—or of the steam-engine—or the discovery of America; for its benefits will truly be *infinite and eternal*: and the contemplated *modes* of carrying out the affair into reality, will be free from all possible rational objections. In order to raise the *money means* for proceeding with the business, it is intended to present proper and respectful "memorials" or petitions, to the Queen, Privy Council, Parliament, &c., to be worded somewhat as follows, so as to give, in as few words as possible, a clear exposition of what is proposed to be done—and the beneficial consequences that would, in a manner, inevitably follow—viz:

Memorial of S. B. R., &c. Your memorialist humbly prays to be granted a *royal patent or charter*, for a new mode of transacting commercial affairs, of every possible description; whereby merchants, manufacturers, agriculturists, traders, and others, may greatly facilitate their ready-money or short credit traffic, and also the settlement of pecuniary accounts generally: the proceedings under the "Charter" will be somewhat as follows—viz.: The empire to be apportioned into, say 200 districts, or sections; each to contain about 100,000 people: In every section there to be appointed a central or sectional agent—together with from twenty to twenty-five local or division agents, with all necessary clerks, and assistants, for carrying on the various operations of the society in contemplation; which society, it is proposed, under all due submission, to name the "Royal British Trade-promoting Commission, or Bounty-Society;" the whole to be conducted, and controlled, according to the conditions of the "charter," and the laws of the land, by a general agent, resident in London, or elsewhere: in each "section" there to be as many merchants, agriculturists, bankers, manufacturers, traders, &c., admitted "certified members" of the society, as may be willing to allow the commission or discount about to be described. The "certificate" of members will be 1*s.* per year, for which sum each of them may, if they think proper, have their name and address inserted in from 2000 to 4000 of the society's "circulars;" many thousands of which will be issued quarterly in every section of the concern, in aid of the business of the members of the same. Every member will engage to pay a prompt *commission, or discount*, to the agents of the society, varying from 2*s.* 6*d.* up to 6*l.*, 8*l.*, or even 10*l.*, per cent.—any an average commission of five per cent. for business done, and money actually received: this commission will, in each and every section, be aggregated by the agents, and placed in duly appointed bankers' hands, until ultimately disposed of in the manner stated below: and as soon as such aggregate shall have amounted to 18,000*l.* (supposing it were all to remain in the bankers' hands—which, of course, would not be the case, owing to the necessary demands upon it for current expenses), which, with moderate exertions of agents and members, and the aid of the steam-press, would be, almost, to a certainty, effected in twelve weeks: the same to be thus apportioned:—

One-twelfth part thereof (*i. e.* 1500*l.* quarterly from each and every of the 200 sections), to be paid into her Majesty's Exchequer, as a just and reasonable equivalent for the charter, &c. prayed for—minus one-sixth part thereof, which is to be presented as a free gift, or "gratitude offering" to her Majesty, and her Royal Consort, for patronising the affair, and thereby enabling your memorialist and his assistants, to find good and profitable employment to all persons in want, or desirous of the same, and consequently to effectually remove the present deplorable national distress, and also all future cause and excuse for idleness, vice, crime, vagabondry, and pauperism, and for the cries of "want of trade," and "want of work," throughout the land! *Three-twelfths* of said aggregate (*i. e.* 4500*l.*) would be required to pay the commissions, salaries, and all necessary office and other expenses of agents, clerks, assistants, &c., of the section, in number about 100 persons; hence, on the establishment of 200 sections, there would, on this account alone, be a demand originated for the labour of 20,000 persons of talent, industry, integrity, and respectability! *Two-twelfths*, or 3000*l.*, would be expended in advertisements, circulars, lectures, books, papers, and special services of individuals, in promotion of the various commercial and other undertakings of the members of the section collectively; and the remaining *six-twelfths*, or 9000*l.*, will be appropriated in gratuities or bounties, to induce persons to become ready-money or short-credit customers to the several members of the society, in every just, honourable, and legal manner possible; the particulars of which inducements it would be totally out of the power of any one to previously define, in consequence of the same depending entirely on the wish or inclination existing at the moment in the minds of the respective members and their several customers, as to all, or any of their commercial, banking, manufacturing, agricultural, or other honest ready-money dealings whatever. All the transactions of the society will be open to every individual in the empire, (and every person will more or less, be interested in the success of the concern)—and, therefore, nothing improper, illegal, unjust, or dishonourable, need be apprehended, throughout the entire affair. However, to guarantee this—there will be appointed, by vote of members, in each and every section of the country, four patrons, two inspectors, one banker, and from twenty to twenty-five guardians, to see that all the affairs of the society, in their respective sections, are conducted in strict accordance with the conditions of the "charter," as before observed, and the laws and general usages of the land: from such arrangements, it would be almost impossible for rational objections of any kind to arise, either against the *principle* or the *plans*, for which your memorialist humbly requests royal leave and licence to carry into effect, and thereby to originate and maintain an infinite demand for labour and talent, of all orders and degrees, and consequently to issue "good tidings to the poor," without encroaching upon the rights and privileges of the rich—to "bind up the broken-hearted," without overtelling, in the slightest manner or degree, the pleasures or enjoyments of the healthy or the happy—to "proclaim liberty to the captives," without expense to any one, or trespassing against any law of either heaven or earth—and "to comfort all that mourn," without let, hinderance, or molestation to any soul alive! And your memorialist, as in duty bound, &c. &c.

This, Mr. Editor, is an outline of the plan by which I propose to raise the *money means* for carrying into effect the "benefit societies" before mentioned: and I can confidently assert, that with *royal patronage*, but not otherwise—the whole affair may be accomplished with comparatively the greatest ease imaginable: as a final result from 200 sections of the "Commission Society" in question, (which may be planted in about two years from the date of the charter)—there would be, 1st, a voluntary contribution of 1,200,000*l.* a-year paid into the Exchequer as an equivalent for the "Charter," &c., minus one-sixth, or 200,000*l.*, as a "gratitude offering" to her Majesty and her Royal Consort, for the patronage solicited. 2d, ample funds would be provided from the just and equitable *private profits* of the concern, to establish a sufficient number of the "benefit societies" to abate all the evils and miseries of pauperism, slavery, idleness, vice, and crime—and, consequently, to remove from the energies of the efficient population of the country, a "dead weight" of probably twenty millions annually. 3d, there would also be the means provided of constructing a magnificent stone bridge across the mouth of the River Severn, at or near to the New Passage, in Gloucestershire, about five miles in length, including the approaches, whereby a railroad, and also a free common road communication would be opened between Bristol and the rich and populous mineral and manufacturing districts of Monmouthshire and South Wales; and on the direct road from London to Cork and Waterford, in Ireland: and 4th, there would be a direct *circulation of money* created to the extent of full 16,000,000*l.* a-year, exclusive of indirect benefits to the State, and to individuals, in a manner, without end. I believe I have now given you a rapid sketch of the principal part of the propositions which are intended to be submitted to the public in detail, as soon as a committee of gentlemen of rank and talent can be formed who will undertake to assist in approaching the throne, and the high powers of the land, in the manner herein contemplated, as far as moral and political influence may be available. Any further information on the subject I shall feel happy to communicate, at all times, provided requests for the same are made to, yours, &c.,

S. B. ROGERS.

Newtyple, Monmouthshire, Feb. 27.

RELATIVE PROPERTIES OF HOT AND COLD-BLAST IRON.

TO THE EDITOR OF THE MINING JOURNAL.

SIR,—In troubling you with this, my second, letter, I am not influenced by the belief that the slightest necessity exists for me, or any other person, to offer further assertions, or arguments, in support of the character of hot-blast iron, as compared to cold-blast iron, or that my respectability of character, or the quantity, or quality, of the intellect, I may be supposed to possess, is in any danger of depreciation from the angry abuse bestowed upon me by Mr. Hartop, in his letter to you of the 13th ult., published in your Journal of the 18th ult. All Mr. Hartop's assertions against the character of the Milton hot-blast iron have been abundantly disproved; his arguments, *if such they can be called*, have been scattered to the winds; and, for his abuse of me he has my thanks, for nothing would gall me more than to be the subject of praise from his pen. But to prevent the possibility of any of your readers misconceiving this matter, I now address you; Mr. Hartop in one of his letters to you, remarked, that in proportion to the rank and standing in society of individuals, so would be the degree of credit attached to their assertions; this is, so far, true, that I feel it necessary to inform those who do not know me, that Mr. Hartop, as the manager, or clerk, at the Elsecar Iron-Works, is in no respect my superior, for although I do not attempt to dignify my communications by dating them from some "Hall" at Hayland, yet, as the managing clerk of Messrs. Graham and Co., no doubt can exist that I am fully his equal, and, unless he can show my assertions to be false, or my arguments fallacious, neither of which he has done—but as I have done both these things by him, I am not *afraid of the opinion of the public* being unfavourable to me. In my letter, I charged him with having convicted himself of misrepresentation; for instance, he put down Scotch hot-blast metal as inferior in value to Yorkshire metal, by 5*s.* per ton; and in the very next sentence, he states the difference to be 32*s.* 6*d.* per ton in favour of cold-blast metal generally; to this charge he has never attempted to reply. Next, I accused him of suppressing the quotations of Mr. Fairbairn's tables, of the six works, making both hot and cold-blast metal, four of which were greatly in favour of hot-blast iron; how did Mr. Hartop answer this? he asserted that he did not publish that portion, because superior specific gravity, modulous of elasticity, breaking weight, and ultimate deflection, were not qualities of the least importance to the public; but, if that were true, why did he not quote the power of those irons to resist impact? for that, he states, is the only question in which the public are interested. Instead of doing so, with his characteristic recklessness, he charges me with the same offence, although he knew that a reference to my letter would show I quoted fully. Such conduct, Sir, I cannot help denominating *a most pitiful subterfuge*. I next charged him with being in alliance with some spy upon these works, upon whose authority he had asserted, that upon a large forge-hammer driving-shaft breaking at this place, five others (of hot-blast iron) one inch larger were cast, all of which broke in the short space of eight weeks, when one from cold-blast iron was cast, which stood its work well; all that statement was denied both by Mr. Hawthorn and myself. But, mark, Sir, how pre-eminently disgracefully he endeavours to evade this charge. 1. He (Mr. Hartop) contradicted Mr. Hawthorn's denial of such breakage having occurred. 2. He stated, I was not at Milton at that time, and could not know anything of the matter; but here, again, he is very unfortunate, for ever since 1829, the books kept at this place have truly chronicled its proceedings, and would have shown it, but I declare they do not, and why? because it never happened. 3. He makes a singularly puerile effort to show he was not indebted to a *spy* for his information; he stated that he passed Milton Works four times a day, and was thereby enabled to see what occurred there for himself. Such of your readers, Sir, who are acquainted with the locality of these works, well know that such a statement is a naked falsehood; but for those who do not, I will describe the situation of Milton forge—it lies in a hole, two sides being close under a hill, one side hid by the two blast-furnaces and casting shops, and the whole roofed over, so as to exclude the interior from the view of any passers by, even if they were upon any other portion of the premises, save and except that narrow portion of the *yard adjoining the lower side of the forge*—a point for observation this veracious gentleman never could reach; but he certainly did pass upon a field ascending the adjoining hill at a distance of some 400 or 500 yards from the forge. But, Sir, what a singular vision Mr. Hartop must possess! ! ! I have heard of an Irishman who had a gun, with which he could shoot round a corner, but never of human eyes endowed with qualities like Mr. Hartop; first, to see what that gentleman asserts he could do in passing, he must be able to throw his glance straightforward for a quarter of a mile, then dart it down perpendicularly some forty feet, piercing through the *roof of the forge*, and then have the power to perceive, *without measuring*, that five driving-shafts had been cast one inch larger than they used to be; but, really, if, Sir, those shafts did break, as he states they did, it must have been occasioned by the clouds of Mr. Hartop's lightning glance falling upon them—how else can you account, Mr. Editor, for their all breaking at that particular moment? But, again, Sir, after such a statement as Mr. Hartop's, in reply to my charge of his being in alliance with a "spy," who can give him credit for probity? But in Mr. Hartop's last letter, he lays claim to the credit of being the designer of the arch used in erecting the aqueduct at Stanley Ferry; I will only observe, in reply, that his right to it is about equal to that of the "cuckoo" who takes possession of another bird's nest. But, apropos of bridges, Mr. Hartop never made but two—one for the Isle of Dearham; the second, a suspension bridge, erected just above Wakefield-bridge; both fell down, the latter carrying with it a waggon and three horses; so much for the engineering skill of this gentleman, or the bad quality of the cold-blast iron of which those bridges were made; but, perhaps, I shall lose sight of Mr. Hartop's vanity, if I ascribe it to the latter circumstance. But it is due to myself to declare, that any further attacks Mr. Hartop may make upon me will remain unnoticed. I have no desire to continue a correspondence, only for the purpose of being scurrilous; if I have been severe, I have founded my observations upon facts and arguments, which Mr. Hartop has proved he is wholly unable to destroy.

Milton Iron-Works, near Sheffield, March 7. JOSEPH PARKES.

[We trust that any further correspondence which may arise on this subject, which has of late partaken too much of a personal and disagreeable character,

will be written with less acrimony, and opinions or facts briefly noted. We are willing to afford our correspondents ample space for the discussion of subjects, but personalities should be avoided, and some little thought bestowed on our readers who may not be interested in the question at issue.]

THE DAVY SAFETY-LAMP.

TO THE EDITOR OF THE MINING JOURNAL.

Sir,—I should, for one, most heartily deplore any attempt to counteract Lord Ashley's truly philanthropic exertions for the amelioration of the miner, but there are at work powerful and influential antagonists—the bane of benevolence, and inimical to every good work, though it is to be hoped, Lord Londonderry's eccentric notion, that the body is more than mind, will be shared in by few. It is not the *sublime*, but the *spiritus intus*, that makes the man, and none would be more startled by the announcement, that his Lordship's horse is superior to his rider, than the noble marquis. The *Times* viewed that in a serio-comic light, which was no doubt meant by the noble author as a figurative flourish. If inattention to the ventilation of the mine has been induced by the introduction of "the Davy," it has, so far, been a questionable boon, but its illustrious author, I am persuaded, never meant it as a substitution for that all-important process. This invention is by no means absolutely safe, and it is owing to an overweening confidence in this belief, sanctioned by one who ought to know better, that care and caution have not been duly exercised. The holder of the lamp falls the victim, and survives not to retort the charge of negligence or reckless carelessness brought against him. Thus, the "lamp" escapes condemnation, by the favouritism due to a "friend." Being a matter-of-fact man, I, of course, like an appeal to facts, and *experimentum fiat* is my motto. On two several occasions—once in Staffordshire, and again in Derbyshire—were safety-lamps put into my hands by the coal viewers themselves, and in whose possession the "Davy" had exploded the ambient medium; and it was a similar accident, in the case of a "Davy," in reference to himself, that proved its questionable security, and led Roberts to the invention of a safety-lamp, founded on different principles—viz., that no more air should be admitted into the cylinder than that required for combustion, and might be consumed by the [illegible] what must be [illegible] obvious to all, with dame. I may merely say, that, [illegible] that as long as this lamp maintains its integrity—that is, the glass cylinder remains entire—such a lamp must be positively safe. The "Davy" is only conditionally safe, and is contingently dangerous. The circumstances under which this safety-lamp proves dangerous, are these:—The transit of a "blower" and current of air, in the process of ventilation, or the transit of the lamp through the air galleries. In the experiments made with three distinct and properly examined "Davy lamps," before the committee of the House of Commons, the lamps constantly exploded. Now, it has been strangely asserted, that this artificial blower was a more severe ordeal, being more powerful than the natural "blowers" of the mine. The reverse conclusion might well be sustained; but those who hazard this outrageous opinion, contrived to forget that the "fire-damp" of the mine, in all its explosive range of combination, has been most rigorously analysed by Henry, Thomson, Davy, and others. As long as the wick flame remains vertical, as in the quiescence of the lamp, it remains a safety lamp, but, when deflected from that plane, and impelled by currents towards the side of the cage, it acts like a blowpipe on the tissue, and may pass through. None can doubt the danger, under such contingencies, of currents of air; or, what amount to the same thing, the movement of the lamp. The remedy, in reference to currents of air and "blowers," is very simple, and is as effective as it is simple:—A shield, or screen, of mica ("muscovy glass")—a substance sufficiently transparent, and at once flexible and elastic, forming a concentric cylinder exterior to the wire gauze, would ward off lateral "blowers," and prevent the agency of currents. There is yet another cause of accident, which I was the first to point out—I mean the substitution of copper wire gauze, instead of the usual iron wire tissue; to this cause I had myself nearly fallen a victim, and, therefore, may truly add—"*Quoque ipse miserrima vidi.*" By the process of screwing and unscrewing the wire gauze from the socket, it is frequently ruffled and torn, and the junction becomes incomplete; an accident from this cause has been pointed out to me. J. MURRAY.

Feb. 28.

ARTESIAN WELLS APPLIED TO MINING OPERATIONS.

TO THE EDITOR OF THE MINING JOURNAL.

Sir,—I have been a quiet, but not uninterested, spectator of the late successful and unsuccessful attempts to form Artesian wells in this and other countries; and, although not so sanguine as to suppose that they may be multiplied sufficient to meet the wants of the population of crowded cities, or be formed on any portion of the ground on which we tread, I still think, that they will be found important auxiliaries to man for many industrial pursuits. It is well known, that the mining districts of England abound with subterraneous reservoirs of water, at very uncertain and very varying depths—that mining operations are frequently disturbed by the sudden inroads of these waters—and that a vast outlay, and constant application of steam power, is absolutely necessary, to enable the miner to extract the mineral wealth from its native bed—in fact, the drainage of mines forms one of the most important items in the preliminary and monthly expenditure of many mines, water being the greatest enemy they have to contend against, occasionally causing mines of undoubted value to be altogether abandoned. These subterraneous waters are local accumulations, continually fed from the surface waters, which percolate through the permeable beds, and are eventually disposed in such kinds of beds, placed at different depths, within the superficial crust of the earth. Now, if an Artesian well be made to meet this accumulation, the consequence is, the liquid element naturally ascends to the surface through the vertical issue, and a continued drainage is established, and, if those accumulations are not wholly disposed of, from the want of efficient power, still, it is most highly probable, that they were drawn from the mineral beds, and thus the object in view is accomplished. In digging the Artesian well a double purpose is attained; we not only have a natural vent for the waters, but we also become acquainted with the mineral strata, and very often may hit upon a rich and productive vein. I do not mean to say that this process may be made universally useful, for, in numerous places, it could not be resorted to, but in large mining districts its great advantages are obvious. In countries such as Guatemala, Cuba, &c., where water is scarce, the supply necessary for washing the ore might be procured by Artesian wells—the more important, as it is well known, that many mines have been abandoned in tropical regions for the want of this important auxiliary. I trust that this short notice of so important a subject will induce some of your scientific readers to turn their attention to it.

London, March 6. ARTESIS.

ENRICHMENT OF MINERAL VEINS.

TO THE EDITOR OF THE MINING JOURNAL.

Sir,—Some of your correspondents appear to hold it as a doubted fact, that all the rocks which mineral veins traverse are contemporaneously produced, and that the metal was primarily a constituent portion of those rocks which it now traverses. Was such the fact in Nature, the enrichment of veins would, of necessity, depend on the nature of the rock, varying with the several transitions of strata through which the veins traverse. Now, it appears that the highest degree of enrichment of the veins is at the junction of two rocks, in soft in preference to hard strata, and in the general composition of the rock; and, so far, the actual nature of the rock exercises a positive influence on the productiveness of veins. Again, it may be observed, that the metals are most generally different throughout the aluminous rocks, which embrace many varieties, known as granite, elvan, killas, greenstone, &c.; but, on the other hand, many of the most productive veins are in granite and other species of rock, which contain little or no aluminous—consequently, we cannot lay down any positive law on the subject. The metallic veins, as it traverses the several beds, which vary much in their elementary constituents, varies also in its quantities and qualities, sometimes bulging out, and from thence passing off in branches, which are sometimes wholly unproductive, and always differing in composition and character: thus, for instance, in the rich copper mines of Tresavean, the lodes have been productive only in the granite near the junction with the slate, and on passing into the slate, it becomes at once impoverished and worthless; on the other hand, the Consolidated and United Mines are the most productive in slate. Wheal Alfred Mine is in elvan, and Lemont contiguous to greenstone, and yet it is manifest that there is a marked difference in the elementary composition of those several kinds of rock. Your correspondent, "A Mining Captain," supposes that the granite and killas were contemporaneously produced, but the junction of the one with the other is extremely uncertain, and in Cornwall and Devonshire these rocks penetrate each other—the killas being also traversed by elvan, greenstone, and other rocks, all varying from each other in chemical composition. That an exchange of elementary constituents often takes place in beds overlying each other is very evident, but this fact is wholly insufficient to account for the difference of killas and granite; and, again, many of these beds are traversed by sandstone and limestone (still more simple in their primary qualities), or by ironstone beds horizontally disposed between these several beds. The confused nature of many of the beds at the point of junction with each other, militates much against this theory of contemporaneous formation, and still more against the theory of metals being generated in the several beds they traverse; in numerous instances, the material of the two beds is so united as to form an intervening stratum, differing in material and qualities from both the upper and underlying beds; and here it is evident, that, when the upper bed was deposited, both were in a soft state, the mineral vein forming during the period of one or both beds consolidating, expanded, contracted, separating, or diverging, under the same law, which prevails in many of the smallest specimens of veins found in rocks and stones. I shall be happy to hear, through the medium of your Journal, how Mr. Hopkins reconciles the very striking difference in the chemical and mechanical combination of rocks to his theory of contemporaneous development, and also the numerous striking varieties in the direction of veins, with his theory of deposition by polar action. It is my opinion, borne out by numerous well-established facts, that the mineral vein claims priority of origin to the metalline matter which it contains—that it gives the form and direction to the metalline body transfused therein, the veins traversing hard rocks, having the least aptitude to receive the metal—that all metalline veins are formed by chemical precipitation, being generated within one particular bed, and carried from thence in veins into beds of a differing nature, accumulating at the entrance of the harder rocks, when the veins in these rocks are replete with metalline matter, and, consequently, further passage is denied. It does not appear that the rock expands to admit the metal, but, in general, the softer the strata is, the greater the degree of enrichment, but very often the metalline products are primary constituents of the rocks with which they are now intimately blended.

Devonshire, Feb. 24. A MINING AGENT.

SOUTH WALES BASIN—PRACTICAL MINING.

TO THE EDITOR OF THE MINING JOURNAL.

Sir,—I should think, by this time, Messrs. Deakin and Thompson must have convinced your correspondent, "J. S. D.," with all his scientific acquirements, which no one has yet questioned—whether geographical, mineralogical, or geological—that the practical miner has a right to approach the threshhold of natural science; and, though surrounded with phenomena of constant occurrence, until Nature has changed her mode of acting, they need not mistrust, or undervalue, the result of their own experience, in the development of underground operations; and I should hope, in future, your Oxford correspondent will display a little more liberality, than allow them to arrive at a certain amount of knowledge, and then disdainfully tell them it is bounded by their native hills. As one of this *mountain race* I feel obliged to him for his compliment; but should you suppose, Mr. Editor, there is nothing amongst these hills which calls for scientific research? I believe the South Wales mineral basin presents a most striking feature, both to men of theory as well as practice; mountain after mountain, in succession, beautifully arranged, intersected with deep and interesting valleys, inlets to those vast sources of minerals in which they abound—a description of which would serve to strengthen the opinion entertained by most of your practical correspondents, on the formation of minerals. By examining these valleys to a certain depth, we find the upper strata, and some of the mineral beds, have been laid bare by the Deluge, but strong enough, in those primitive ages, to resist the violence of the retiring element; trace them to the sides of the mountain, there is to be found the overlying strata taking its regular position, and rocks to an amazing thickness, producing materials for the erection of the works; through most of these valleys flow the dimpling streams, often increased by the mountain torrent, and, in their progress, set in motion the ponderous machinery which finishes and prepares for the use assigned them, the produce of this vast mineral deposit.

Aberguesney, Feb. 27. A SOUTH WALES COLLIER.

THE LIFE-BOAT.

TO THE EDITOR OF THE MINING JOURNAL.

Sir,—I am glad to find that a public barometer for the use of the mariners has been sometime established at Whitby, and another, more recently, set apart for this purpose at Brighton. Were the oracles of science consulted, incalculable would be the advantages in cases like these. Science, it is too true, has, alas! too often subserved the purposes of a toy, or been merely made to minister to amusement—*pour passer le temps*. We must now, however, found an argument against its vast importance or intrinsic value, founded on its abuse. Insect creations may minister to atheistical reveries, but legitimate electricity has nobler and more enduring functions to perform. I have been led to these reflections by an anxious wish to see mental exertions directed into a right channel, and made subservient to purposes of practical good. I cannot but deem it to be highly discreditable to a maritime nation like ours, that Government should be so insensible and inattentive to such a question as the saving of the shipwrecked, when sums voted for the destruction of life pass without question. Surely, a more benevolent dawn will yet arise, and "the time of refreshing" come at last. Among the means pre-eminently calculated to aid in saving from shipwreck, the "life-boat" is chief in the list. Amendment or improvement here, however, is never thought of, and the vast majority of the so-called "life-boats" are at once a misnomer, and a solemn mockery. I remember when at Blyth, in 1810, that a "life-boat," constructed by Greathead (the presumed inventor of the life-boat), on being launched into the deep, was dashed to pieces, and the crew drowned; and, not long ago, a similar catastrophe took place on the same line of coast. The "life-boat" at Whitby, some years ago, sunk! and that at Scarborough has the extraordinary property, when capsized, of not "righting" again, remaining with the bottom upwards! About six or seven years ago, ten persons were drowned off Scarborough under such circumstances, and a like accident, with loss of life, with the same "life-boat," took place only a short time since! Are these crazy fallacies, and dangerous decoys, entitled to the noble name they bear?—I think not. I repudiate, in *toto vocis*, the substitution of air boxes for cork in life-boats, which a very slight accident might render inutile; and, for my own part, I should as soon think about being drowned in a drawing-room, as in a life-boat, such as I consider a "life-boat" ought to be. I will soon send you my proposed improvement, submitted, with a model, to the Shipwreck Institution of Paris.

Feb. 29. J. MURRAY.

ELECTRICITY IN METEOROLOGY.

TO THE EDITOR OF THE MINING JOURNAL.

Sir,—Mr. J. Murray does not overrate the importance of electricity as connected with meteorology, although I cannot think the principle, so simple and effective on the Adriatic shores, will be found equally applicable in this damp changeable climate of ours. Experience points out to us, that electrical disturbances in the atmosphere are not the certain indications of storms; for in the months of August and September those disturbances are greatest when the weather is continuously dry and sultry, and sudden changes of the winds have sometimes the effect of increasing, and at other times of decreasing, this disturbance; but, as we approach the Equator, the air is charged with a greater quantity of electric matter, and extraordinary excitement almost invariably forebodes a coming storm. Before a cloud is seen rising in the horizon in the West Indies, its coming is denoted by intense electric action, affecting the animal and vegetable creation; without a breath of wind, the leaves of the forest tremble violently, the birds of the air and beasts of the field retreat screaming to cover, and every living thing unconsciously announces the approaching tornado; the hot, dry, pestilential winds of the deserts, and of the East Indies, and the approach of an eruption from a volcano, present the like phenomena. At sea, the excited state of the charged atmospheric volumes may or may not be the signal of a coming storm, for sometimes the tempestuous current sweeps by a vessel absolutely becalmed. Again, the rapidity with which a storm passes on the open sea would admit of few or any preparations to meet it. If the indications of the conductor and marine barometer were to be implicitly acted upon, there would be a continued call for reefing and unreefing sails, and it is generally acknowledged, that old experienced seamen have many infallible signs by which they foretel a coming storm; thus, the typhoon announces itself by a distant ripple of the water, and even this notice is many times insufficient to save the vessel from being dismasted; the meteoric gleams that flicker about the masts are most generally the accompaniments, and not the forerunner, of storms, and they cannot, therefore, give that practical lesson for our government which Mr. Murray supposes; still, I am quite of his opinion, that the resources of electricity, in relation to meteorology, are very insufficiently examined and applied. ÆOLUS.

Cheltenham, Feb. 28.

ON MARINE LIGHTNING CONDUCTORS.

TO THE EDITOR OF THE MINING JOURNAL.

Sir,—A short time ago, a notice appeared in the *Hampshire Telegraph*, of a lecture I had delivered to the *Literary* and Philosophical Institution, at Chatham, "On Electricity and Marine Lightning Conductors," some remarks in which bore upon what I considered erroneous statements, which Lieut. Sabben had previously made, on the same subject, at Portsmouth. Mr. Sabben wrote to the Editor of that paper a very uncourteous letter in reference to those remarks, to which I felt myself called upon to reply; but the Editor of that paper refused to insert any further communications on the subject. My only object in making any communication on such a matter was, to encourage the confidence which truth, when it is entertained with candour, is apt to inspire in the minds of those who are the most interested in its statements; and to divest our seamen of the groundless fears to which they may be subject through a want of correct information. As I observed, in your Journal of the 28th ult., a notice of such articles in that paper, with an apparent bias to the side of the question contended for by Mr. Sabben, I trust you will do me the favour of inserting the following remarks, which express my opinions in relation to the two forms of lightning conductors, whose merits are asserted by opposite parties:—

The question at issue is, the comparative merits of Mr. Snow Harris's copper conductors, inlaid in the masts, from the royal-mast-head to the step of the mast, and there connected with the copper sheathing on the outside, by means of bolts passing through the keelson—and wire-rope conductors, extending from the upper extremity of the masts, over the side of the ship, into the water. This involves the *efficiency* and the *safety* of the two modes of carrying off the electric fluid which may fall on the mast of a ship. The objections to the fixed metallic conductors appear to arise from their being *inlaid* in the masts, from the *angular* junction at the mast-head and topmast-head, and from their being *carried through the ship*.

In the objection to the manner of fixing the conductors, there seems to be a fallacy, arising from a misapprehension of the character of electricity, since it proceeds upon the assumption that the electric fluid requires for its passage such freedom in the line provided for it as would be necessary for a grosser fluid, whereas, the extreme subtility of this fluid renders such a condition altogether unimportant; hence the part of the surface of the conductors which is let into the mast is, in reality, as eligible to the transmission of electricity as the outer surface. Nor does the least danger arise from having any portion of the metal surrounded with wood; no obstruction is thereby presented to the passing of the current; nor is it, in any way, conducive to explosion. It has lately been attempted to be shown that the contrary to this is the truth, by a partial statement of a fact that occurred to a nobleman's yacht, which had been struck by lightning, and in which the fluid, in endeavouring to escape through the side, by a metal bolt, exploded, and injured the wood-work; but the fact was, that the explosion was caused by a want of continuity in the conducting medium, which did not extend to the external surface of the vessel. General statements are always less satisfactory than particular facts; and with regard to such statements as are made, of frightful chasms being formed in the sides of ships by electrical explosion, as the result of the fluid being unable to make its way to the sea by means of the bolts on which it had seized, it may be confidently averred that if these bolts, being of sufficient capacity, had formed an uninterrupted line to the water, or external sheathing, no fact would ever have *appeared* to warrant the statement that it is dangerous to bring the fluid through a ship, by means of the copper plate conductors attached to the mast, and thus to keep alive the fear of a proximity to so uncontrollable an agency. When once the laws to which the operations of nature are subject become objects of our knowledge, our reasonings and our conduct may, with the most conclusive certainty, be determined in conformity to such laws. The laws of electrical action have become known to a great extent, and are not liable to any inferences that would countenance those fears; and as, under the same conditions, there is an unvarying similarity in electrical action, so the laws which govern it, as they become more generally known, have an immediate tendency to dissipate all those unsubstantial apprehensions which are concomitant with ignorance. It is one of the most obvious of these laws, that, when a volume of electric fluid passes through space, it selects for itself the best and most direct conductor that is present; and it may be easily verified that if two conductors of similar conductibility be so placed that there is no circumstance besides the general law that can determine which the electric fluid will traverse, and if one of these conductors has its continuity unbroken, whilst the other consists of two parts which are separated by a very small interval, the electric fluid will *invariably* seize on that of unbroken continuity; but if *that* be removed, it will as readily traverse the other, passing over the small interval by which the parts of it are separated. Further, if the space through which the fluid passes be occupied by any number of pieces of good conducting matter, placed in any promiscuous disorder whatever, the determinate course of the electric fluid is such, that only those pieces whose position is nearest to a right line will be traversed by it, whilst the others will remain unaffected; but, if the intervals between the pieces are short, the fluid will pass over each of them in succession to seize on the good conducting substance that is nearest in the line, until it has reached the extreme point to which it moved, rather than traverse a bad conducting substance, happening to be in the vicinity, although its continuity might be unbroken. If, now, these demonstrable truths be considered, in connection with the mode of fitting the permanent conductors on the masts, it will be apparent how groundless are the objections to the angular junctions at the mast-head and topmast-head, since all the other continuous lines from those points are of far inferior conductibility, as wood, rope, &c. Hence, the course of the electric fluid to the lower extremity of the mast is not subject to any obstruction occasioned by the form of, or the manner of fitting, the conductors.

One of the other current objections to these conductors is, that there is a danger of explosion if the electricity be conducted through the ship. I am not aware that it is stated in any of the controversial papers which have appeared on this subject what are the conditions, in connection with these conductors, which render explosion a subject of rational apprehension. I believe, however, that the conditions of safety are easily explicable; and experiment has supplied numerous proofs that it requires nothing more than metal of good conductibility, sufficient capacity, and uninterrupted continuity. Now, since an iron cylinder of half an inch diameter is estimated to be sufficient to carry off the heaviest charge of electricity that is known to fall from any thunder-cloud, a copper cylinder of the same diameter would be more than is absolutely requisite for such a purpose, since its conductibility greatly exceeds that of iron. But the capacity is still greater as the dimensions are larger; and the continuity is entire throughout the ship. It does not appear, therefore, that any injury is likely to occur from a want of conductibility, capacity, or continuity; and, from what has been already said, it does not appear that the manner of inlaying the conductors in the mast at all diminishes the capability or safety of conduction. One other ground of alarm is a notion that lateral explosion is likely to take place; but as this notion is not supported by a reference to any facts which would tend to verify or illustrate it, and, as far as I have been able to learn, no instance of the kind has yet been recorded. Since, therefore, lateral explosion appears to affect nothing but the imaginations of those whose intelligence on this subject needs improvement, and others whose judgments are misled, and whose fears are awakened, by their unfounded statements, it appears high time that this notion were either eliminated and verified, or excluded from a place in scientific discussions. The truth of these statements has been proved by many facts; and the evidence of these facts demonstrate the fallacy of the statements by which it is attempted to be shown that the one of them is dangerous, or that it is not calculated to ensure the entire safety of ships to which they are applied, so far as the manifestation of electrical agency affects them.

What are, now, the merits of the wire-rope conductors? It appears that they are pretended to be superior, in consequence of their carrying off the charge of electric fluid without conducting it into the ship. Now, as all will admit that this arrangement, viewed simply as an arrangement, does not diminish their effectiveness, so, I contend, from the principles of electrical science, and from all the facts which can be taken as valid evidence in the case, that it does not increase their effectiveness. As the fixed conductors on the masts supply the ship to which they are fitted with a *perfect* protection from injury by atmospheric electricity, no increase of security can, of course, be realised, by using a different form of conductors. But are they, on other grounds, equally eligible? The general facts in the history of lightning conductors answers in the negative. The evidence given to the committee, at Somerset House, relating to the chain conductors which have been used in the navy, is, that they were kept packed up in a box, and usually stowed away in the store-rooms, and were taken up only when it was apprehended they would be wanted; and that, as thunder squalls arise suddenly and unexpectedly, especially in the tropics, the damage is done to the ship before they can be got out and taken up. "In 1814, on board the Thunderer, the men had not left the conductor five seconds when the lightning descended with extreme violence, and in one instance, on board a vessel in the mouth of the Mondego, several men were struck dead at the moment of hoisting one up." As uncertainty of future prospects clearly as much on the discretion of the commanding officer in the case of the wire-rope as in that of the chain conductor, so greater security is secured to the navy by substituting the wire rope for the chain; for when it is entirely a matter of choice whether the conductors shall be always fixed or not—and the indisputable testimony of naval officers is, that the chain conductors, under the same conditions, were generally in the store-room—it must require a peculiar course of argument to make it appear to the generality of readers that the same contingency does not apply equally to wire-rope conductors. In addition to this, they are liable to be broken, in common with other ropes; and when is such an accident more likely than in a storm? If it may occur in a storm, the liability is not less in a thunder storm than in one in which an excess of electricity does not manifest itself. As soon as such an accident is found to have occurred, and a man is ordered to connect the ends—either by splicing them, or by a knot—he forms a part of the circuit, and becomes obnoxious to the destructive violence of the electric fluid, should a thunder cloud at that time hover over the ship. Again, who would assume himself of the safety of the man whose duty it might be to strike the topgallant-mast, or topmast, during a thunder storm, when the wire-rope, as well as other ropes, is flying about in all directions; and the men engaged in taking in the cloak are in danger of being entangled in its perpendicular, and of forming a part of the circuit? It is obvious to every slight consideration that, should an electrical charge descend whilst the men were performing this duty, they would be in a very perilous, if not in a fatal, position. Such being clearly the case, the men cannot proceed to that part of their duty with any confidence of safety while engaged on it; whereas, the fixed conductors afford a perfect protection to the men, as well as to the masts and ship; and there can be no more ground of apprehension from the discharge of electric fluid upon them than if it were as harmless as the summer breeze.

In conclusion, it may be remarked, that the comparative power of the metallic plate, and of the wire-rope conductors at present used, to carry off a charge of electric fluid, is as follows:—taking a copper cylinder of three-fourths of an inch in diameter to be one, that of the wire-rope conductor would be half, and that of Mr. Harris's conductors of the most perfect would be *one and a half*.

Chatham, *Feb.* 28. JOHN FORBES.

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